DISARMAMENT

Facts 74

Towards a Nuclear-Test Ban

United Nations

Preface

The cover reproduces the emblem of the United Nations and the emblem of the World Disarmament Campaign, a global information programme on disarmament and international security launched by the General Assembly in 1982 at its second special session devoted to disarmament. The programme has three primary purposes: to inform, to educate and to generate public understanding of and support for the objectives of the United Nations in the field of arms limitation and disarmament. In order to achieve those goals, the programme is carried out in all regions of the world in a balanced, factual and objective manner.

As part of the programme's activities, the Department for Disarmament Affairs provides information materials on arms limitation and disarmament issues to the non-specialized reader. Such materials cover, in an easily accessible style, issues which may be of particular interest to a broad public. This is one such publication. It is published in the official languages of the United Nations and intended for world-wide dissemination free of charge.

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Towards a Nuclear-Test Ban

Background

There are five declared nuclear-weapon States in the world today. The United States was the first to conduct a nuclear-weapon test, in 1945, followed by the Soviet Union in 1949, the United Kingdom in 1952, France in 1960 and China in 1964. In 1974 India carried out an underground explosion of a nuclear device, stating that the explosion took place for peaceful purposes only.

Tests are conducted to develop and refine the design of nuclear weapons and to check their reliability.

From 1945 until the end of 1989 a total of 1,818 nuclear explosions were carried out in all environments - in the atmosphere, in outer space, under water and underground - 921 by the United States, 643 by the Soviet Union, 177 by France, 42 by the United Kingdom, and 31 by China. India carried out a nuclear explosion in 1974.*

The unprecedented scale of destructiveness of the two bombs that exploded over Hiroshima and Nagasaki in August 1945 (200,000 persons died within the first five months, another 100,000 were injured, and an indeterminate number were victims of long-term radiation effects) and the hazardous radioactive fall-out from tests,

* SIPRI Yearbook, 1990 (Oxford, Oxford University Press, 1990), p. 57.

particularly atmospheric tests carried out in the 1950s, caused mounting concern throughout the world. A number of incidents around testing sites increased the international community's awareness of the spread of radioactive nuclear fall-out and of the mechanisms by which radioactive substances are transferred to body tissues through the food chain. The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), which was set up in 1955, concluded that the only way to prevent the danger of hazardous radioactive fall-out was to ban all nuclear-test explosions. A ban on the testing of nuclear weapons was suggested, either as an independent measure or as one element in an agreement on more comprehensive measures of disarmament.

In the following decades, discussions on - and sometimes negotiations on - limiting nuclear tests and the pursuit of a comprehensive test ban have been held in various forums: at the trilateral Conference on the Discontinuance of Nuclear Weapon Tests in Geneva, held from 1958 to 1962, which involved the Soviet Union, the United Kingdom and the United States; in the Eighteen-Nation Committee on Disarmament in Geneva and its successor bodies for disarmament negotiations (today known as the Conference on Disarmament); at the trilateral negotiations from 1977 to 1980 between the Soviet Union, the United States and the United Kingdom; at the General Assembly of the United Nations at its regular sessions and at its three special sessions devoted to disarmament. Bilateral negotiations between the Soviet Union and the United States

on nuclear testing that began in November 1987 with the aim of reaching agreement, as a first step, on verification measures to make possible the ratification of the 1974 and 1976 test-limitation Treaties, have resulted in the signing of new verification protocols in June 1990.

The Partial Test Ban

By the end of 1956, the different approaches of States to the issue of a ban on nuclear testing had become quite clear: the Soviet Union and India advocated an early and separate agreement on a ban on all nuclear tests without international verification, maintaining that no significant testing could go undetected; Yugoslavia, representing the view of an emerging group of non-aligned States, urged an agreement with such control as might prove necessary; and the Western countries regarded the limitation of and eventual ban on nuclear testing, with adequate verification, as part of a comprehensive disarmament process.

Following a conference of experts from Eastern European and Western States held in 1958, which concluded that it would be technically feasible to establish a workable and effective control system to detect violations of an eventual agreement on the suspension of nuclear tests, the Soviet Union, the United Kingdom and the United States began negotiations on a test ban in Geneva (the Conference on the Discontinuance of Nuclear Weapon Tests). They also suspended their testing and maintained that voluntary ban for about three years. In the course of the negotiations

the positions of the two sides came closer than they had been at any earlier time. As a result of increased tensions in the overall relationship between the three Powers, however, the negotiations adjourned in 1962 and were not resumed. Nevertheless, the momentum that had been built upon the issue of a nuclear-test ban did not entirely dissipate.

Although differing positions on the question of on-site inspection made an underground test ban impossible, in 1963 the Soviet Union, the United Kingdom and the United States were able to agree on a partial approach, signing the Treaty banning nuclear-weapon tests in the atmosphere, in outer space and under water, but not underground (partial test-ban Treaty). Hence no nuclear tests in the atmosphere, in outer space or under water have been carried out by them since 1963. It is estimated that from 1963 to the end of 1989 the United States conducted 590 underground tests, the Soviet Union 458, and the United Kingdom 19. France and China have not become parties to the Treaty. France announced in 1974 that it would refrain from conducting further atmospheric tests. Since then it has carried out 128 underground tests. China conducted its last atmospheric test in 1980; in March 1986, it confirmed that it would not conduct atmospheric tests in the future. China has conducted 11 underground tests since 1969.* By 31 January 1991, 117 States adhered to the Treaty.

* SIPRI Yearbook, 1990 (covering the period up to the end of 1989), p. 57.

The partial test-ban Treaty was the first international agreement of world-wide scope reached in the field of nuclear-arms limitation. At the time, its conclusion was hailed as an event of historic significance that marked the beginning of the curbing of the nuclear-arms race. Indeed, it helped to create a climate that facilitated negotiations for other agreements, notably the Treaty on the Non-Proliferation of Nuclear Weapons, and it has also greatly contributed to reducing radioactive pollution and to lessening international tensions.

The Threshold Test-Ban Treaty and the Peaceful Nuclear Explosions Treaty

In the partial test-ban Treaty, States parties expressed their determination to pursue further negotiations aimed at the discontinuance of all test explosions of nuclear weapons in all environments for all time. Such negotiations were held during the 1960s and 1970s at the multilateral level, in the Geneva Committee on Disarmament; at the bilateral level, between the Soviet Union and the United States; and at the trilateral level, between the Soviet Union, the United Kingdom and the United States. The major obstacle in all those negotiations continued to be the question whether a total ban on testing could be adequately verified and whether verification would require on-site inspection.

As a result of their bilateral negotiations on the banning of all nuclear testing, the Soviet Union and the United States, in 1974, signed the Treaty on the Limitation of Underground Nuclear Weapon Tests, commonly referred to as the threshold test-ban

Treaty. This Treaty prohibits any underground nuclear-weapon test having a yield in excess of 150 kilotons and restricts testing to specified areas. Each party agreed to use its national technical means of verification and not to interfere with the means of verification of the other party. The parties also agreed to exchange information necessary to improve the assessments of the yields of explosions. The threshold test-ban Treaty does not, however, cover underground nuclear explosions for peaceful purposes. Negotiations continued, therefore, on this question.

In 1976 the two States signed the Treaty on Underground Nuclear Explosions for Peaceful Purposes. This Treaty regulates the explosions which they may conduct outside their nuclear-weapon-test sites and which may, therefore, be presumed to be for peaceful purposes. To ensure that explosions announced as peaceful would not provide weapon-related benefits that could not be obtained from weapon-testing prohibited by the threshold test-ban Treaty, the new Treaty established the same yield threshold for explosions for peaceful applications as that which had been imposed on weapon tests, namely, 150 kilotons. Any group explosion is also limited to 150 kilotons unless each of its individual explosions can be identified and each yield determined to be not more than 150 kilotons, and the aggregate yield does not exceed 1.5 megatons. In a Protocol containing specific operational arrangements, the two parties committed themselves to provide detailed information on their explosions for peaceful purposes and even to

permit designated personnel of the other party to come within the area of explosion for observation purposes. Those provisions were considered as representing a significant advance in verification procedures.

Following further negotiations and agreement on two protocols detailing verification arrangements for the two treaties, both were ratified by the Soviet Union and the United States and entered into force on 11 December 1990.

Bilateral negotiations

In connection with a new round of negotiations on nuclear and space arms, the Soviet Union and the United States, in 1986, began substantive discussions on issues related to nuclear testing. Full-scale stage-by-stage negotiations on nuclear testing began in November 1987. The United States and the Soviet Union stated that, as a first step in their negotiations, they would agree upon effective verification measures which would make it possible to ratify the 1974 threshold test-ban Treaty and the 1976 peaceful nuclear explosions Treaty, and then proceed to negotiating further intermediate limitations leading to the ultimate objective of the complete cessation of nuclear testing as part of an effective disarmament process. Among other things, this process would pursue, as its first priority, the reduction of nuclear weapons and, ultimately, their elimination. In implementing the first objective of these negotiations - agreement on effective verification measures for the threshold test-ban Treaty - the two sides agreed to design and conduct a joint verification experiment at each other's test sites.

Accordingly, in 1988 the Soviet Union and the United States carried out joint verification experiments at their respective test sites in Semipalatinsk and Nevada, comparing hydrodynamic verification equipment directly on site and seismometric verification instruments at different off-site locations.

At the heart of the present discussions and the joint test measurement experiment is the question: To what extent do off-site seismic measuring devices need to be supplemented by a more intrusive on-site monitoring method? In the American view, seismometric measuring cannot replace on-site monitoring. The American side has, therefore, suggested that all nuclear-test explosions above a yield of 50 kilotons should be verified by the other party through the hydrodynamic or "CORRTEX" method, whereby a cable is inserted into a parallel shaft very close to the shaft containing the nuclear device and the explosive yield is determined by measuring the speed with which the cable is crushed. In discussing the relative merits of the hydrodynamic and seismometric methods for measuring explosive yields, Soviet experts have expressed the opinion that, although the accuracy of CORRTEX measurements can be fairly high if no special measures to distort (camouflage) the explosive yield have been taken in designing the container holding the nuclear charge, the hydrodynamic method requires more extensive and lengthy preparations than does seismic monitoring and does not result in measurements of much greater accuracy. The former method would also entail the risk of obtaining technical information not directly related to the yield of the

explosion. The Soviet side has, therefore, favoured relying on seismic monitoring at a distance from the test site, possibly supplemented by a limited number of on-site measuring operations to calibrate and assure the accuracy of the seismic techniques.

The Soviet Union and the United States consider that their joint tests of the two methods have reduced differences between them regarding the requirements for adequate measuring of underground nuclear-test explosions and have made it possible for them to agree on verification arrangements allowing for the ratification of their 1974 and 1976 Treaties. Although United States officials have stated in that context that they have not identified any further testing limits that would be in American national security interests, and that nuclear testing must continue until nuclear deterrence is no longer deemed necessary, both the United States and the Soviet Union have reaffirmed their intention to proceed with further negotiations in the step-by-step process agreed on. They have stated that those verification measures for the threshold test-ban Treaty that they have been able to agree on as a result of the joint experiments will be used, to the extent appropriate, in nuclear-test limitation agreements that they may conclude in the future.

Multilateral discussions

Faced with continuing nuclear testing, the international community has sought, through the years, to take effective measures that would lead to a comprehensive test ban. Multilateral efforts to achieve this objective have intensified, in particular in the

Conference on Disarmament and its predecessors. A number of concrete proposals, including texts for a draft treaty put forward by Sweden and by the Soviet Union, have been submitted in the course of these discussions.

In the Final Document of the first special session of the General Assembly devoted to disarmament, held in 1978, it was recognized that the cessation of nuclear-weapon testing would make an important contribution to the goal of ending the qualitative improvement of nuclear weapons and the development of new types of such weapons, and of preventing their proliferation.

The divergence of views among the nuclear-weapon States on the question of a comprehensive test ban has, however, made it impossible for the Geneva negotiating body to start substantive negotiations on the issue, despite numerous requests by the General Assembly.

In July 1980, for the first time since they had begun trilateral negotiations on a comprehensive test ban, in 1977, the Soviet Union, the United States and the United Kingdom reported to the Committee on Disarmament that they had agreed that a treaty would require each party to prohibit, prevent and not carry out any nuclear-weapon test explosion at any place or in any environment under its jurisdiction; that a protocol on nuclear explosions for peaceful purposes would be an integral part of a test-ban treaty, establishing a moratorium on such explosions until arrangements for conducting them had been worked out; and that national technical means of verification would be used. Each party would undertake not to interfere with such

means of verification. International seismic data centres would be established in agreed locations to permit an international exchange of seismic data. The treaty would also allow a party, after stating its reasons, to request an on-site inspection for the purpose of ascertaining whether or not an event was a nuclear explosion. The three Powers concluded their report by stating that they were determined to exert their best efforts to bring the negotiations to an early and successful conclusion.

However, no further talks were held between them after the United States announced, in 1982, its decision not to resume the trilateral negotiations on a test-ban treaty. The United States held that any consideration of a complete cessation of testing must be related to the ability of Western States to maintain credible deterrent forces and, while a test ban remained an element in its full range of long-term arms control objectives, the United States did not believe that, under the current circumstances, a comprehensive test ban would help to reduce the threat of nuclear weapons or to maintain the stability of the nuclear balance.

A compromise was reached in the Committee on Disarmament in 1982, when an *ad hoc* working group was established "to discuss and define, through substantive examination, issues relating to verification and compliance with a view to making further progress towards a nuclear-test ban". China and France, however, made it known that they would not participate in the Working Group. In the course of subsequent deliberations, further treaty proposals were presented: by the Soviet Union in the General Assembly in 1982 and by Sweden in the Conference on Disarmament in

1983. Between 1984 and 1989 the Conference on Disarmament was again unable to agree on the terms of reference for a new working group, namely, a mandate to begin substantive multilateral negotiations in the Conference on Disarmament. In 1990 it found a compromise enabling it to re-establish an *ad hoc* working group to initiate substantive work on specific and interrelated test-ban issues, including the structure and scope of a treaty as well as verification and compliance.

The importance that Member States continue to attach to a comprehensive nuclear-test ban is reflected in various initiatives that they have taken.

On 6 August 1985, the Soviet Union publicly declared and put into effect a unilateral moratorium on all nuclear tests. The moratorium lasted, with four renewals, until 26 February 1987. The Soviet Union, at that time, announced its willingness to resume a moratorium if the United States would do the same.

In a document adopted in 1986 in Mexico, the members of the Six-Nation Initiative - Argentina, Greece, India, Mexico, Sweden and the United Republic of Tanzania - offered to assist in monitoring a moratorium or ban on nuclear-weapon tests. They proposed that they, in co-operation with the United States and the Soviet Union, establish and operate, first on a temporary and later on a permanent basis, monitoring stations at existing test sites, and that they "internationalize" a number of selected stations in each of the two nuclear-weapon countries by placing observers there.

Another approach towards concluding a comprehensive test-ban treaty was taken by a group of non-aligned countries, which, beginning in 1985, proposed that

a conference be convened to consider converting the partial test-ban Treaty into a comprehensive one. The 1963 Treaty stipulates that its depositary Governments (USSR, United Kingdom and United States) must convene a conference to discuss an amendment if at least one third of the States parties request it, and that any amendment must be approved by a majority of all the parties including the three depositaries. By early in 1989, the required number of States parties (39) calling for the convening of such a conference was reached. The Soviet Union welcomed the idea of expanding the scope of the 1963 Treaty. The United Kingdom and the United States indicated that, although they would comply with the request in accordance with their duty as depositaries, they did not support the proposed conversion. Following the holding of the Meeting of the States Parties for the Organization of the Amendment Conference in June 1990, the Conference itself was held in New York from 7 to 18 January 1991. As the Conference was unable to reach a unanimous conclusion, it adopted, by vote, a decision in which the States parties acknowledged the complex and complicated nature of certain aspects of a comprehensive test ban, especially those with regard to verification of compliance and possible sanctions against non-compliance, and expressed the view that further work needed to be undertaken. Accordingly, by the same decision the President of the Conference was mandated to conduct consultations with a view to achieving progress on those issues and resuming the work of the Conference at an appropriate time. The decision was adopted with 74 votes in favour, two against (United Kingdom and United States), with 19 abstentions.

In 1986 and again in 1987 the General Assembly adopted resolutions by which it called on States conducting nuclear-test explosions to notify the Secretary-General, within one week of each explosion, of the time, place, yield and site characteristics of the test and also invited all other States to provide any such data on nuclear explosions that they might have. It also requested the Secretary-General to make available an annual register, based on the information provided. So far, Australia, New Zealand and the Soviet Union have furnished such information.

Over the years, in the Conference on Disarmament, members of the Group of 21 (mostly neutral and non-aligned countries) have continued to attach the utmost importance to the urgent conclusion of a comprehensive test-ban treaty as a significant contribution to the aim of ending the qualitative refinement of nuclear weapons and the development of new types of such weapons as well as of reversing the nuclear-arms race and achieving nuclear disarmament. Commenting on the negotiations between the two major nuclear-weapon States on nuclear testing on a stage-by-stage basis, they reiterated their view that the existing bilateral thresholds did not preclude the modernization of nuclear weapons and thus failed to contribute to the cessation of the qualitative development of nuclear weapons. Rather than verifying those thresholds, what was required, in their view, was that all nuclear tests be prohibited. Intermediate agreements to limit testing would have a useful purpose only if they served to curb the qualitative development of nuclear weapons and constituted steps towards the conclusion of a comprehensive test-ban treaty.

Members of the Group of Eastern European and other States continued to regard the earliest elaboration of a treaty on the complete and general prohibition of nuclear-weapon tests as among the most urgent and significant measures for halting the nuclear-arms race and preventing the proliferation of nuclear weapons. They expressed their conviction that a prohibition of nuclear-weapon tests was the key to halting the nuclear-arms race and to checking considerably the refinement of nuclear weapons, thus bringing closer attainment of the ultimate goal of a nuclear-weapon-free world.

The USSR has repeatedly stressed its continued commitment to an early achievement of a comprehensive test ban and its readiness to use all possibilities leading to the fulfilment of that objective. While pursuing with the United States full-scale stage-by-stage negotiations leading to a complete ban on nuclear testing, it has continued to support parallel efforts within the Conference on Disarmament aimed at the preparation of a multilateral treaty on the complete and general prohibition of nuclear-weapon tests. The USSR has also subscribed to the idea of extending the 1963 partial test-ban Treaty to underground nuclear tests.

Throughout these years the United States has reaffirmed that a comprehensive test ban remains its long-term objective, to be achieved in the context of significant reductions in the existing arsenals of nuclear weapons, the development of substantially improved verification measures, expanded confidence-building measures and a greater balance in conventional forces. The United States has stated that it views nuclear testing issues in the broader context of national security and that, as long as it

must rely on nuclear deterrence for its security and for that of its allies, testing would remain essential. In that context, the United States had not identified any further limitations on nuclear testing, beyond those now contained in the partial test ban Treaty. Against that general background it was opposed to the proposal to amend the 1963 partial test-ban Treaty. However, it has pointed to the successful completion of the joint verification experiment, and of negotiations with the Soviet Union on verification protocols to the threshold test-ban Treaty and the peaceful nuclear explosions Treaty, which have allowed for verification, and has stated that it remains committed to negotiations with the Soviet Union in the context of a step-to-step approach to ending nuclear testing. With regard to the role of the Conference on Disarmament, the United States has reaffirmed its readiness to participate in multilateral discussions on nuclear testing at the Conference under an appropriate non-negotiating mandate.

The United Kingdom has expressed the view that its security would depend for the foreseeable future on deterrence based, in part, on nuclear weapons; this would mean a continuing requirement to conduct underground nuclear tests to ensure that its nuclear weapons remained effective and up to date. The United Kingdom has welcomed the moves to ratify the threshold test ban Treaty and the peaceful nuclear explosions Treaty. It has expressed the belief that, following such ratification and as verification technology improved, and also taking account of progress in other areas of arms control, further steps to control nuclear testing would have to be considered. Although a comprehensive test ban continued to be a long-term goal, it has remained firmly of the

view that an immediate move to a comprehensive test ban would be premature - even destabilizing. For these reasons, among others, the United Kingdom has stated its opposition to the proposal to amend the partial test-ban Treaty in order to convert it into a comprehensive test ban.

France has maintained that international commitments in the field of nuclear testing can be considered only in the overall context of nuclear disarmament and has stressed that the cessation of nuclear-weapon testing is not a pre-condition for progress towards nuclear disarmament but, on the contrary, could become significant at the end of a long-term process resulting in real and effective nuclear disarmament. France has emphasized that it could not agree to the obsolescence of its limited nuclear deterrent and that only the nuclear explosions necessary to maintain its credibility had been conducted. France has also stressed that, in the context of deep reductions of nuclear weapons, the problem of reliability of the remaining weapons could, in its view, only become more important. France has underlined that it would not stand in the way of any procedural agreements that might be reached to deal with the item in the Conference on Disarmament, but it has reaffirmed that it is not in a position to participate in work the objective of which was the negotiation of an agreement to which it could not subscribe.

China has stated that it has always stood for a comprehensive prohibition and thorough destruction of nuclear weapons, including the cessation of nuclear tests. In its opinion, the two States possessing the largest nuclear arsenals should take the lead in halting the development, production and deployment of all nuclear weapons and in

drastically reducing their nuclear arsenals; China would be prepared to take corresponding measures in the process of cessation of the nuclear arms race and nuclear disarmament. China has reiterated its flexible position towards the various proposals submitted thus far on the mandate for a subsidiary body of the Conference on item 1 of its agenda. China has also reiterated that if and when agreement is reached on the mandate, enabling such a body to be established, it would participate in its work.

International seismic monitoring

The question of adequate verification procedures has remained one of the major problems in the multilateral consideration of a comprehensive test ban. Over the years, a number of proposals has been made with a view to solving the issue, for example by Sweden and by the Soviet Union.

On the assumption that adequate means to deter any clandestine testing under an agreement could be provided by a global seismic monitoring system, Sweden proposed in 1975 that the Conference of the Committee on Disarmament set up, early in 1976 an *ad hoc* group of scientific experts to study this possibility.

The *Ad Hoc* Group of Scientific Experts to Consider International Co-operative Measures to Detect and Identify Seismic Events was established in 1976 with a mandate to devise a conceptual design for an international seismic data exchange system and to test its various components. The Group of Scientific Experts (GSE) is

open to all member States of the Conference on Disarmament, as well as to non-member States upon request. Over the years, experts and representatives from 35 countries in all have participated in the work of the *Ad Hoc* Group.

A verification system for a comprehensive test-ban treaty would have two basic purposes: to provide confidence that other parties to the treaty are obeying their treaty obligations, and to deter parties from clandestine activities violating the treaty. A verification system must provide a high capability to detect and identify clandestine activities. It must further limit the risk of creating false alarms by misinterpreting naturally occurring events as clandestine activities. For instance, many earthquakes would be observed and would have to be confidently identified. A large number of false alarms would rapidly deteriorate the credibility of the verification system and thus of the treaty itself.

The system developed by the Group is intended to be a service to those countries which are parties to a test-ban treaty, and should provide them with easily accessible information derived from globally collected data. The judgement whether a nuclear explosion has taken place or not would be left to the individual States parties.

The first of five reports so far was submitted in 1978 and described how seismological science could be used in a co-operative international effort to develop a global seismic data exchange system. The report envisaged a network of more than 50 high-quality seismograph stations distributed world-wide and operated according to

agreed procedures to produce seismic data in standard form on two levels: Level 1 with routine daily reporting of basic parameters of detected seismic signals; and Level 2 with records of waveforms provided in response to requests for additional information. Level 1 data would be regularly exchanged using the Global Telecommunications System (GTS) of the World Meteorological Organization (WMO) and other available means of communication. Data would be routinely compiled and processed at special International Data Centres (IDCs) for the use of participating States. The much more voluminous Level 2 data would be exchanged only for those seismic events determined by participants to be of particular interest. No processing of such data at International Data Centres was foreseen in the first report.

Over the next several years, the Group systematically defined the elements of such an international co-operative data exchange system, and elaborated its basic scientific and technical aspects. This work was supported by practical co-operative tests of parts of the proposed system. The first large-scale technical test of the Group was carried out in 1984. In this test 75 seismograph stations in 37 countries took part and a vast amount of experience was obtained on many aspects of the practical operation of a global seismic data exchange system.

In order to take advantage of the new possibilities offered by recent scientific and technological developments, in 1986 the Group proposed a modernized and

upgraded system to be based on the expeditious exchange of waveform (Level 2) and parameter data (Level 1) data and the processing of such data at International Data Centres. The system would have four major components:

- A global network of more than 50 high-quality seismograph stations, including seismic arrays, each conforming to specified technical standards and operated according to internationally agreed rules.
- Government-authorized National Data Centres (NDCs) responsible for providing seismic data from national stations to IDCs.
- International Data Centres to collect and analyse seismic waveform and parameter data; to distribute, on a daily basis, bulletins with information on all observed events; and to make data and results readily accessible to all participants. For the purpose of developing IDC procedures and of facilitating testing of the global system, four Experimental International Data Centres (EIDCs) have been established in Canberra, Australia; Stockholm, Sweden; Moscow, USSR; and Washington D.C., United States.
- Telecommunication channels for the expeditious exchange of data, between National Data Centres and the International Data Centres as well as between the International Data Centres.

The Group is at present conducting a large-scale experiment to test the proposed concept. The first two stages of this experiment were carried out in 1989 and 1990.

In this experiment data are transmitted by various means of communication from the National Data Centres, one in each participating country, to the four Experimental International Data Centres. So far 27 countries have joined in the test by contributing data from in all more than 50 stations. Standardization procedures are being used for the processing of data to determine the location, depth and other information related to the source for all detected seismic events.

In addition to a global seismological verification system, verification arrangements under a comprehensive test ban treaty might also include the monitoring of atmospheric radioactivity. A global system for the collection of airborne radioactivity could in principle be quite similar to the seismological system designed by the Group of Scientific Experts. About 100 globally distributed, technically fairly simple, air sample stations would provide data on airborne radioactivity either in the form of small particles or of radioactive gas. The data obtained would have to be analysed and compiled in specially equipped laboratories.

Satellite images of the surface of the Earth could give valuable contributions to the verification of a nuclear test ban by monitoring the infrastructure and other evidence of nuclear testing in selected areas, such as existing test sites and areas where peaceful nuclear explosions have been conducted. Another application could be to use

satellite data to assist in the interpretation of seismic events which have not been confidently identified as earthquakes using seismic data. If satellite data show that an event is located in an area which lacks the infrastructure (for example roads, which would be necessary to prepare for and conduct a nuclear explosion), the possibility of a clandestine test might be excluded. Satellite data might thus prove useful in reducing the number of unidentified earthquakes and thus reduce the number of potential false alarms about clandestine tests.

On-site observations and inspections play an increasingly important role in arms control and disarmament treaties, and are likely to become of significant importance also in the context of a comprehensive test ban treaty. There are at present no seismological methods available to distinguish chemical explosions from nuclear explosions. On-site inspections, conducted upon invitation, could be used in connection with large chemical explosions to confirm that such explosions are non-nuclear. Inspections could also be used to increase confidence that a seismic event, which might prove difficult to identify unambiguously from seismological data or satellite observations, is an earthquake and not a nuclear explosion.

A nuclear-test ban and the question of the non-proliferation of nuclear weapons

In the preamble to the 1963 partial test-ban Treaty, the three negotiating parties - the Soviet Union, the United Kingdom and the United States - committed themselves to seek to achieve the discontinuance of all test explosions of nuclear weapons for all time, and expressed their determination to continue negotiations to that end. In the preamble to their 1974 threshold test-ban Treaty, the United States and the Soviet Union made a specific reference to that declaration of intent.

During discussions in the mid-1960s on the prevention of the further proliferation of nuclear weapons, there was a general feeling among the non-aligned members of the negotiating body in Geneva that a non-proliferation treaty should offer a balance of responsibilities and obligations between the nuclear-weapon and the non-nuclear-weapon States, and that it should either become a part of a wider disarmament programme or be followed by an early halt in the production of nuclear weapons and a reduction in the stockpiles of the nuclear-weapon States. To meet this particular concern, the Treaty on the Non-Proliferation of Nuclear Weapons contains a provision under which each of the parties to the Treaty undertakes to pursue negotiations in good faith on effective measures relating to cessation of the nuclear-arms race at an early date and to nuclear disarmament, and on a treaty on general and complete

disarmament under strict and effective international control. The Treaty also included, in the preamble, a reference to the declared intention of the parties to the 1963 partial test-ban Treaty to seek to achieve the discontinuance of all test explosions of nuclear weapons for all time and to continue negotiations to that end.

In 1995 a conference will be convened to decide whether the non-proliferation Treaty will continue in force indefinitely, or will be extended for an additional fixed period or periods. Many States support the view that a comprehensive test ban would be a significant contribution to the non-proliferation of nuclear weapons; and some believe that, without a cessation of nuclear testing, it may not be possible to extend the NPT well beyond 1995. Other States, however, are of the opinion that the NPT, independently, offers benefits for the security of all States and, by its extension, will continue to do so.

Whatever the viewpoint, it seems clear that the issues of nuclear testing and the non-proliferation of nuclear weapons will continue to command much governmental and public attention in the years to come.

Short Glossary and Acronyms

Conference on Disarmament

Known as the Committee on Disarmament between 1979 and 1983, the Conference on Disarmament is the multilateral negotiating body of the international community, currently with a membership of 39 States, including all five nuclear-weapon States. The Conference was constituted in 1978 and held its first session in 1979, carrying on the negotiating efforts of its predecessors, the Ten-Nation Committee on Disarmament (1959-1960), the Eighteen-Nation Committee on Disarmament (1962-1969), and the Conference of the Committee on Disarmament, comprising 30 Member States (1969-1978). It has a unique relationship with the United Nations. It defines its own rules of procedure and develops its own agenda, taking into account the recommendations made by the General Assembly and reports to the General Assembly annually, or more frequently, as may be appropriate. The Secretary-General of the Conference is appointed by the

	Secretary-General of the United Nations and acts as his personal representative. In 1979, the Committee on Disarmament agreed on a permanent agenda consisting of ten subject areas from which it adopts its annual agenda and programme of work.
CCD	Conference of the Committee on Disarmament (see Conference on Disarmament).
CORRTEX	Continuous reflectometry for radius versus time experiment.
ENDC	Eighteen-Nation Committee on Disarmament (see Conference on Disarmament).
Fission	The splitting of the atomic nuclei of certain heavy elements (such as uranium and plutonium), which results in the immediate release of great energy, as in a fission-type nuclear weapon (atomic bomb).

Fusion	The process whereby the nuclei of light elements, especially those of isotopes of hydrogen, combine to form the nucleus of a heavier element, resulting in the immediate release of great energy. This process constitutes the basis of the thermonuclear weapon (hydrogen bomb), which can be vastly more powerful than the fission-type or atomic nuclear weapon.
Kiloton	A measure of the yield of a nuclear detonation. One kiloton is equivalent to 1,000 tons of TNT. TNT is the universally used acronym for the chemical explosive trinitrotoluene.
National technical means of verification	National technical means (NTM) are devices under the control of a State that can be used for monitoring at a distance actions by another State. This includes the monitoring by one State of compliance by another State to ensure implementation of the provisions of a treaty to

which they are both parties. NTM include observation satellites, aircraft-based systems such as radios and cameras, and sea- and ground-based systems.

NPT

Treaty on the Non-Proliferation of Nuclear Weapons. The Treaty was opened for signature on 1 July 1968 and entered into force on 5 March 1970. Its aims are to prevent the spread of nuclear weapons from nuclear-weapon States to non-nuclear weapon States, to promote the process of nuclear disarmament and to facilitate access to nuclear technology for peaceful purposes. The Treaty defines the obligations of both nuclear-weapon and non-nuclear-weapon States parties regarding the prevention of the further spread of nuclear weapons. It further commits both nuclear-weapon and non-nuclear-weapon States to pursue negotiations, in good faith, on nuclear disarmament and the cessation of the nuclear arms race. The Treaty also

provides for safeguards to be administered by the International Atomic Energy Agency to prevent diversion of nuclear material from peaceful to weapons uses.

Nuclear explosive device

Any nuclear explosive. The term is most frequently used to indicate that a nuclear explosion from such a device would not have a military purpose.

Nuclear weapons

A collective term for atomic and hydrogen weapons of all types and their delivery systems.

PNE

Nuclear explosions for peaceful purposes. Test or applied nuclear explosions intended for peaceful engineering projects, such as making underground minerals accessible, or major construction projects involving topographical alteration.

Plutonium

In the context of weapons, plutonium usually refers to the fissile isotope plutonium-239, which occurs in nature only in minute quantities. It is manufactured artificially when an extra neutron is added to uranium-238 through irradiation. It is used, as an alternative to highly-enriched uranium, for the core of atomic bombs.

Treaty

A treaty, whatever its particular designation, is an international agreement concluded in written form between two or more States (bilateral or multilateral treaties) and governed by international law. It may be embodied in a single original instrument or in two or more related instruments.

Uranium

A radioactive element (atomic number 92) with an average atomic weight, in natural ore, of 238. The two principal natural isotopes are uranium-235 (0.7 per cent of natural uranium), which is fissionable, and uranium-238 (99.3 per cent of natural uranium), which is fertile, i.e., readily absorbs neutrons through irradiation to produce the fissionable material plutonium-239. Uranium-238 alone cannot sustain a chain reaction.

Yield

The energy released in the detonation of a nuclear weapon, measured in terms of kilotons or megatons of TNT required to produce the same energy release.

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